



Six-Spotted Mite

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Photo 1. Adult female six-spotted mite and spherical egg on the underside of a grapevine leaf.

Six-spotted mite (SSM), *Eotetranychus sexmaculatus* (Riley) (see Photo 1) caused significant damage to foliage in a winegrape vineyard in the south-west of Western Australia in 2006. This mite, which is native to the Americas, was first recorded in Western Australia in 1986 on imported avocado seedlings. In the same year and presumably from the same source, SSM was recorded also for the first time on avocados in New South Wales, Queensland and South Australia. The mite had not been considered a pest in Western Australia and still occurs in the original avocado orchard.

The future pest status of SSM in Western Australian vineyards or other crops is unclear, but an awareness of whether the mite is present is the first point in minimising its potential for damage.

Damage

SSM feed primarily on the lower surface of leaves, concentrating their activity adjacent to leaf veins. During feeding, the mites penetrate the host plant with their stylets and suck out the cell contents. This results in discolouration of leaf tissue. On grapevines, signs of SSM presence on white and red grape varieties are yellow or red shadows respectively, on either side of the veins and visible from both sides of leaves (see photos 2 (a) and (b); 3 (a) and (b)). Occasionally leaves may also appear distorted.

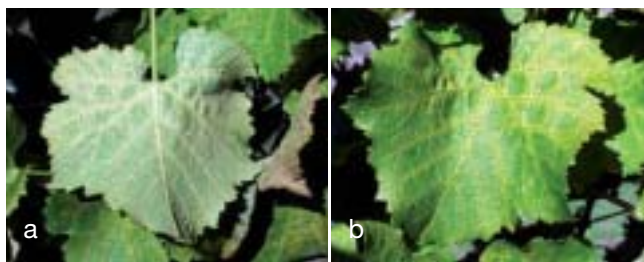


Photo 2. Six-spotted mite damage to white grape varieties. (a) Underside of a grapevine leaf of Semillon showing yellow feeding damage by six-spotted mite adjacent to the leaf veins. (b) The upper side of the same leaf showing the feeding damage is also obvious on this side.

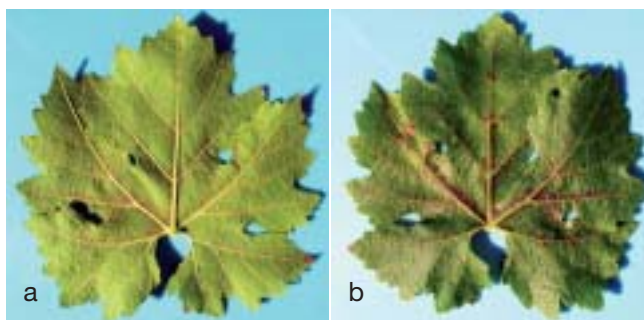


Photo 3. Six-spotted mite damage to red grape varieties. (a) Underside of a grapevine leaf of Cabernet Sauvignon showing red feeding damage by six-spotted mite adjacent to the leaf veins. (b) The upper side of the same leaf showing the feeding damage is also obvious on this side.

On avocado leaves, SSM feeding appears as purpling next to leaf veins (see Photo 4 (a) and (b)). In citrus, major feeding is also common on the leaf stems and occasionally the fruit stems, which will cause the fruit to yellow and fall.

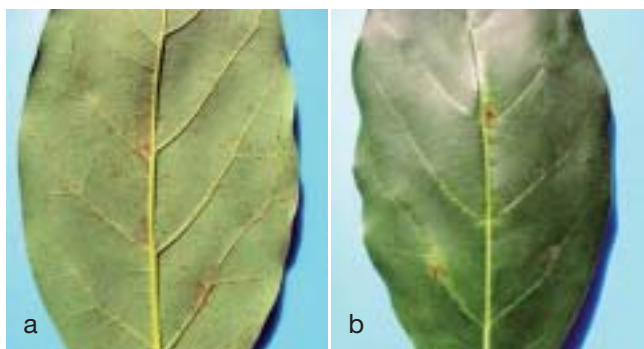


Photo 4. Leaf feeding by six-spotted mite on avocado leaves results in a purpling effect adjacent to leaf veins – on the (a) lower and (b) upper leaf surfaces.

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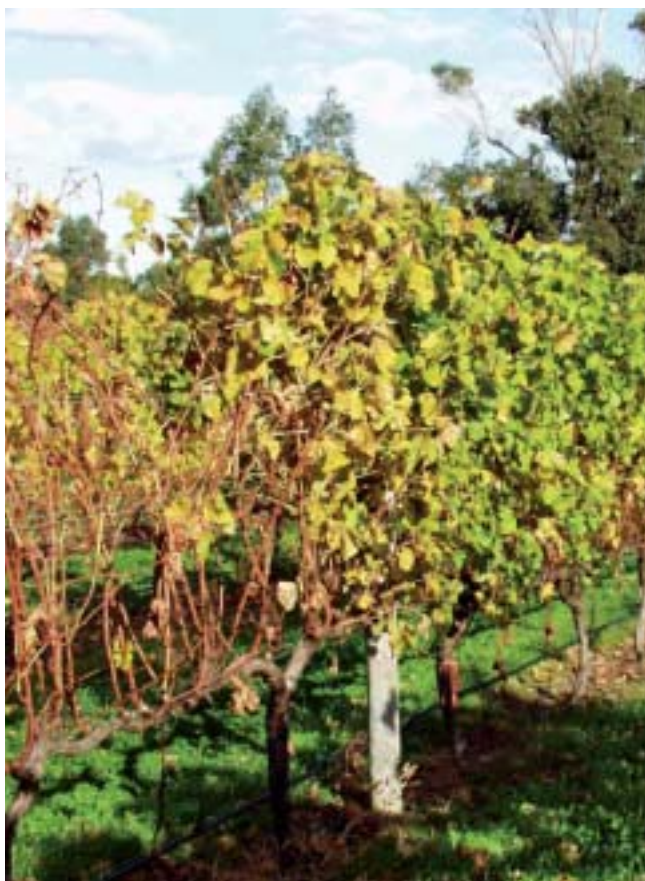


Photo 5. Premature leaf fall caused by an infestation of six-spotted mite evident in Semillon vines in a trial to assess efficacy of chemicals. The panel of vines retaining leaves had been treated with an effective chemical.

Severe infestations of SSM can result in reduced quality and yield of fruit and defoliation can worsen these effects as well as exposing fruit to sunburn (see Photo 5). Avocados are particularly susceptible to defoliation.

Pest status

SSM is capable of a rapid increase in numbers and is usually recorded as a secondary pest after the use of broad spectrum pesticides.

This mite has been a major pest of avocados in New Zealand, but while SSM has been present in the Pemberton avocado orchard for 20 years, it has not caused any significant damage there. SSM was the most common mite on kiwi fruit in New Zealand in the 1970's. In Florida, this mite is a seasonal pest of occasional importance on citrus, primarily grapefruit but also oranges.

In New Zealand, the six-spotted mite is recorded only occasionally in grapevines and is considered a minor or non-pest. However, this mite is currently causing economic damage in a portion of one commercial vineyard in Western Australia, having been first noticed there in 2004.

In California, a damage threshold for avocados is 5 to 10 mites per leaf when leaf drop occurs. Observations in Western Australia suggest a much higher density can be tolerated in vineyards.

Life Cycle and Identification

SSM has five stages in its life cycle:

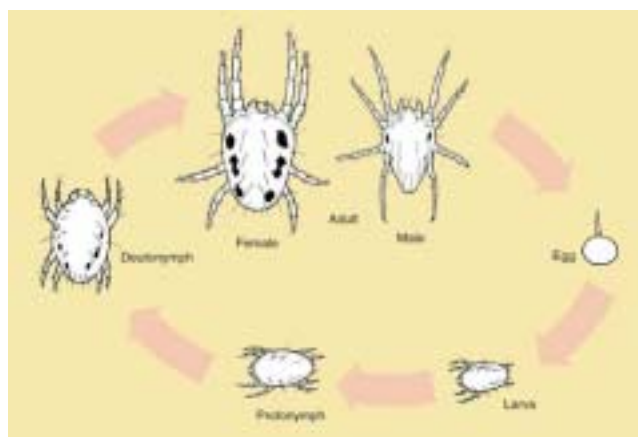


Fig. 1. Life cycle stages of six-spotted mite: Egg, six-legged larva, eight-legged protonymph, deutonymph, adult (female left, male right). (Reproduced courtesy US Dept. Agriculture, Co-operative Extension Service, Univ. Florida).

The life cycle can be completed in as little as 14 days in summer, but longer in cooler conditions. All stages of SSM occur mainly on the underside of leaves.

Eggs: SSM eggs are very small, translucent-white and spherical. The eggs have a short stalk or mast on the upper side that is visible under a microscope. SSM females lay 25 to 40 eggs over a period of 10 to 20 days. Eggs require 5 to 21 days to hatch, depending on temperature.

Immature mites: Once the eggs hatch, the mites go through three active/feeding immature stages before becoming adults. These immature stages look like the adults except they are smaller and the first stage nymphs or larvae have only six legs. Each of these immature stages is followed by a resting period when mites anchor themselves to the host plant and a new cuticle is formed before the old skin is cast. These immature stages can take as little as eight days to complete during summer.

Adults: The adult SSM is very small and measures about 0.3 mm long, but easily visible with a 10X hand lens. Adults are pale yellow to cream, have eight legs and three dark markings on each side of the body (see Photo 1). Despite the mite's common name, the number and shape of these markings may vary considerably. Many long hairs or bristles are also present on the upper body surface. The female is plump and oval in shape while the male is smaller, thinner and has a tapering abdomen (see Fig. 1). The mite overwinters on evergreen hosts such as citrus and avocados in all stages with large populations reported following colder winters. It is not known how SSM overwinters on deciduous crops such as grapevines.

Looks-Like

The adult six-spotted mite is easily confused with two-spotted mite (TSM), *Tetranychus urticae* (see Photo 6). The main difference between these species is the presence of two dark bands on the 'shoulders' of two-

spotted mite. Microscopic examination is required for correct identification. Damage symptoms in grapevines from TSM are more likely to be a yellow stippling across leaves.



Photo 6. Adult female two-spotted mite and spherical egg. Adults differ from six-spotted mite in having only two dark bands on the 'shoulders' of the mite.

Distribution

The origin of SSM is central America. In the United States of America, SSM has been a problem mainly on citrus and avocados in Florida, but occurs as a minor pest in California. SSM has been a major pest of avocados in New Zealand, and to a lesser extent on kiwi fruit and grapevines. SSM has been recorded on avocados in eastern Australia but is not considered to be a pest. In Western Australia, the mite has been confirmed to occur only in the south-west on grapevines and avocados. Of 12 vineyards surveyed in the autumn of 2006 around the original infestation, SSM was found on eight.

Spread

SSM is able to disperse through the air using silk threads (Stevens, 2001). They may also be distributed via field workers' clothing, on equipment and machinery and movement of infested plant material. Dispersal is unlikely to occur on hand harvested fruit, but in the case of mechanically harvested grapes, mites would be present.

Habits

SSM prefers areas of higher humidity. This is reflected in the mite feeding on the less exposed underside of leaves and adjacent to leaf veins, as well as its distribution within infested trees. For example, on citrus they live on interior leaves and spread to the outer leaves of the canopy as the infestation progresses.

Host Plants

There are many plant species that have been listed as hosts for six-spotted mites world wide. These include **fruit and ornamentals** such as: alders, apple, avocado, azalea, berryfruit, camphor tree, false acacia, fig, firethorn, grapefruit, guava, hydrangea, Indian laurel, Indian sorrel,

Japanese cinnamon, kaki, kiwi fruit, lady palm, lemon, maple, mulberry, oak, oleaster, orange, paulownia, peach, plum, poinsettia, pomello, rhododendron, rose, rubber tree, strawberry, wampee and winegrapes. And **weeds**, such as: dock, marshmallow and nightshade.

Monitoring

SSM is most readily detected if the characteristic discolouration adjacent to leaf veins is present (see Photos 2, 3 and 4). If SSM is suspected, check the underside of leaves along the main veins for mite activity using a 10X hand lens. To confirm that SSM is present, microscopic examination is required.

Control

An Integrated Pest Management approach should be implemented to manage this pest.

Biological

There are several predaceous insects and mites and a fungal disease that have been recorded feeding on six-spotted mites in other countries. Similar agents that occur in Australia are the predatory ladybird beetle *Stethorus* sp. (see Photo 7); an unidentified species of predatory thrips which could be six-spotted thrips (*Scolothrips sexmaculatus*) and a predatory mite *Amblyseius* sp. (See Photo 8). Generalist predators such as lacewings and fly larvae may also occur.

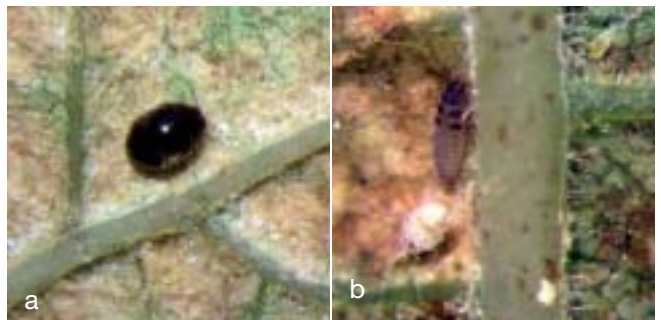


Photo 7. (a) Adult and (b) larva of *Stethorus* predatory beetle on grapevine leaves infested with six-spotted mites.



Photo 8. Predatory mite *Amblyseius* sp. feeding on six-spotted mite adult in a laboratory observation.

Stethorus beetles were the most abundant predator in the heavily infested vineyard. Predatory thrips were present in very low numbers. A laboratory observation indicated that the predatory mite *Amblyseius* sp. will feed on SSM. Field work on this species is required to assess its usefulness as a biological control agent.

Unfortunately, the Chilean predatory mite, *Phytoseiulus persimilis*, which is commercially available and a voracious predator of some pest species of mites, has been shown to not attack SSM.

Cultural

Many ground cover plants may support populations of the six-spotted mite such as the weeds mentioned above. Controlling such plants will aid management of SSM.

Predators can be encouraged by minimising road dust (see Photo 9).



Photo 9. Rows of grapevines adjacent to a dirt road are more heavily infested with six-spotted mite than vines further away. Dust control may help with managing this pest by reducing interference to predators.

Chemical

There is concern about the development of resistance to miticides by six-spotted mite in New Zealand avocado orchards. Therefore, a resistance management strategy should be implemented based on chemical rotation selecting from a range of suitable miticides.

Horticultural spray oils have been used successfully as a suppressant, requiring multiple sprays two to four weeks apart.

Contact the nearest Department of Agriculture and Food Office for the latest chemical control methods.

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